

COMPLEX FORMATION HISTORY OF HIGHLY EVOLVED BASALTIC SHERGOTTITE, ZAGAMI.

T. Niihara¹, K. Misawa², T. Mikouchi³, L. E. Nyquist⁴, J. Park^{5,6}, H. Yamashita⁷, D. Hirata⁷. ¹CLSE, Lunar and Planetary Institute, Houston, Texas 77058, USA. Email: niihara@lpi.usra.edu. ²Natl. Inst. Polar Res., Japan. ³Univ. of Tokyo, Japan. ⁴NASA Johnson Space Center, USA. ⁵Rutgers Univ., USA. ⁶Lunar Planet. Inst., USA. ⁷Kanagawa Pref. Museum of Natural History, Japan.

Introduction: Zagami, a basaltic shergottite, contains several kinds of lithologies such as Normal Zagami consisting of Fine-grained (FG) and Coarse-grained (CG), Dark Mottled lithology (DML), and Olivine-rich late-stage melt pocket (DN) [1-3]. Treiman and Sutton [4] concluded that Zagami (Normal Zagami) is a fractional crystallization product from a single magma. McCoy et al. [1] suggested that there were two igneous stages (deep magma chamber and shallow magma chamber or surface lava flow) on the basis of chemical zoning features of pyroxenes which have homogeneous Mg-rich cores and FeO, CaO zoning at the rims. Nyquist et al. [5] reported that FG has a different initial Sr isotopic ratio than CG and DML, and suggested the possibility of magma mixing on Mars. Here we report new results of petrology and mineralogy for DML and the Olivine-rich lithology (we do not use DN here), the most evolved lithology in this rock, to understand the relationship among lithologies and reveal Zagami's formation history.

Results: The petrological and mineralogical features of DML are consistent with those reported by McCoy et al. [3]. The Ol-rich lithology consists of coarse-grained olivine, pyroxene, plagioclase (maskelynite), phosphate and dendritic spinel. Three different types of olivines are found in this lithology: subhedral to anhedral olivines (~200 μm ; Fa_{97-99}), vermicular olivine (reacted with Si and P-rich melt; original size of ~3 mm; Fa_{97}), and symplectite (~10 μm ; Fa_{89}). K-rich late stage melts ($\text{K}_2\text{O} \approx 7$ wt. %) occur in the Ol-rich lithology and DML. These melts contain laths of hedenbergite, fayalite, and maskelynite. Symplectite occurs at the rim of pyroxene and are break-down products from pyroxferroite as in other evolved shergottites [e.g., 6]. Pyroxene grains in DML and the Ol-rich lithology have homogeneous cores with tiny bands of exsolution lamellae. The cores of those pyroxene grains have significantly different Fe/Mg compositions. Pyroxene in the Ol-rich lithology has an iron-rich composition ($\text{En}_{39}\text{Fs}_{46}$) relative to that in DML ($\text{En}_{56}\text{Fs}_{32}$). From the mantle to rim of pyroxene grains, both pyroxenes share the same Fe, Mg, Ca, and Al zoning features.

Conclusion: Different pyroxene core compositions between DML and the Ol-rich lithology imply that the two lithologies crystallized from different melts which had different Mg-numbers on the early crystallization sequence. This feature is consistent with Sr isotopic signatures that show different initial Sr compositions among the lithologies [5, 7]. DML and the Ol-rich lithology mixed late in the crystallization sequence and cooled rapidly.

References: [1] McCoy T. J. et al. 1992. *Geochim. Cosmochim. Acta* 56:3571–3582. [2] Vistisen L. et al. 1992. *Physica Scripta* 46:94–96. [3] McCoy T. J. 1999. *Geochim. Cosmochim. Acta* 63:1249–1262. [4] Treiman A. H. and Sutton S. R. 1992. *Geochim. Cosmochim. Acta* 56:4059–4074. [5] Nyquist L. E. et al. 2010. *Meteorit. Planet. Sci.* 45:A154. [6] Aramovich C. J. et al. 2002. *Am. Mineral.* 87:1351–1359. [7] Misawa K. et al. 2012. *Meteorit. Planet. Sci.* (this volume).